

**REMARKS**

Reconsideration of the present application is respectfully requested.

The thoroughness of the examination of this application, as indicated by the detail and completeness of the examiner's Action, is gratefully acknowledged.

**I. Claims; Amendments**

Claims 1-34 and 54-65 have been withdrawn from consideration by the Examiner.

These claims are cancelled by this paper. Claims 35 to 53 and 66-67 remain pending in this application.

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Various informalities have been corrected by appropriate amendment to the specification.

With regard to the textual amendment to page 9, lines 8-14, it is noted that the first symbol in a sequence is assigned an index of "0". (See, page 9, lines 6-7.)

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Also included is an amendment requesting the deletion of Dennis John Underwood as a named inventor since his inventive contribution is no longer being claimed in this application.

A Request under 37 C.F.R § 1.48(b) to delete Dennis John Underwood as a named inventor accompanies this Response.

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Various claims have been amended in the manner indicated to overcome rejections and to more particularly point out and more distinctly claim the present invention.

Claims 66 and 67 are "data structure" claims that have been amended to claim the specific data structures produced by the practice of the methods and programs of the claims remaining in this application.

Claim 68 has been added to this application. This claim is directed to a computer-readable medium containing instructions for controlling a computer system to discover one or more patterns in two sequences of symbols  $S_1$  and  $S_2$  by performing the steps of the method of claim 35. A claim directed to this subject matter is believed to be properly joinable in the present application. Other computer readable storage medium claims (i.e., "program" claims)

and their corresponding method claims have been left together. See, for example, the claims selected by the examiner for inclusion in Group I.

## II. Declaration

Enclosed with this paper is a photocopy of the undersigned's file copy of the Response filed Response to Notice of Missing Parts mailed September 12, 2001. This Response includes the Declaration requested by the examiner.

## III. Drawings

In response to the examiner's requirement a complete set of formal drawings is enclosed herewith.

Original drawing Figures 2, 7 and 11 have been replaced by Figures 2A, 2B; by Figures 7A, 7B; and by Figures 11A, 11B, respectively.

Appropriate amendment has been made to the specification.

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Attached to this Response is a copy of original drawing Figure 7 having a proposed drawing amendment indicated thereon. The proposed amendment is the deletion of the "minus" sign in the first row of the "RAW" data table (0, 1).

It is noted that formal drawing Figure 7A submitted herewith reflects the correction.

## IV. Claim Objections

The Examiner has objected to informalities in claims 35, 43, and 53. The noted informalities have been corrected by the amendments submitted herein.

Specifically, claim 35 has been amended to make the language more clear. In step c) the word "columns" was inserted to correct an erroneous omission in the original. The additional language makes clear that one of the k columns is a "primary" column and the remaining (k-1) columns are "suffix" columns, consistent with the specification at page 31, lines 3-13. The term "primary" (rather than its appositive "first") is chosen for consistency with language in other pending claims (e.g., claim 42).

With regard to claim 35, step (i), it is noted that the original punctuation "first, primary, column" was not intended to indicated a series of entities, but is, in fact, an appositive denoting that that a "first" one of the columns is the "primary" column. This fact has now been made clearer by the present amendments. The original punctuation for the appositive was correct.

The suggested amendments to claim 43 and claim 53 have been effected.

#### IV. Rejection Under 35 U.S.C. § 101

Claims 35-53 and 66-67 stand rejected under 35 USC § 101 “because the claimed invention is directed to non-statutory subject matter”.

This rejection is traversed.

The invention is directed to methods and programs for finding patterns in sequences of symbols.

On a broad scale a sequence of symbols is, in and of itself, a physical thing. A “sequence” cannot exist in a vacuum. A sequence is an organization of “things”. The “things” may be rendered in a three-dimensional form, in a printed form, or in an electronic form.

Accordingly, selecting those “things” contained within a sequence that exhibit a pattern is inherently a physical result.

The conclusion is even more emphatic when one considers that patterns of symbols within a sequence represent information, such as important sequence similarities across different genes represent genetic information. Since State Street Bank & Trust Company v. Signature Financial Group, Inc., 47 USPQ2d 1596 (Fed. Cir. 1998), the law is clear that the manipulation of data representing information (e.g., dollars) is sufficiently “useful, tangible and concrete” to qualify as statutory subject matter under 35 U.S.C. § 101.

The operations on the sequences of symbols by the methods and programs of the present invention to identify patterns in the sequences is no less useful, tangible and concrete than the data manipulation to determine dollar amounts found eligible for patent protection in State Street Bank, supra.

With specific regard to claims 66 and 67, these claims are also directed to statutory subject matter.

It is not the mere fact that the data structure is contained in the computer that makes the claim statutory. It is the fact that the data structure represents an organization of information useful in controlling a computer system to discover one or more patterns in k-sequences of symbols. The data structure is needed to enable the computer to identify the patterns in the sequences being considered. Under the holding of In re Lowry, 32 USPQ2d 1031 (Fed. Cir. 1994), such a data structure defines statutory subject matter.

#### V. Rejections under 35 U.S.C. § 112

Claims 35-53 and 66-67 have been rejected as indefinite under 35 U.S.C. § 112, Second Paragraph.

Each rejected claim is treated separately.

A. Claim 35 Pages 4 through 7 of the Office Action contain nine rejections directed toward various portions of claim 35. These rejections are discussed in turn.

1. With regard to the rejection starting on Page 4 concerning claim 35, step (b), it is noted that the preamble clearly states that the k-sequences of interest are part of “an overall set of w sequences”. A master offset table is created for each sequence. Thus, w such tables be created. The claim has been amended to make this clearer. (Page 30, lines 23-24)

2. With regard to the rejection starting on Page 5 concerning claim 35, step (b), the w offset tables are a necessary predicate to utilized to create the k-tuple table of step c. The claim has been amended to make this clearer.

3. With regard to the rejection on Page 5 concerning claim 35, step (c), the amendment to claim 35 inserting the word “columns” avoids any perceived ambiguity.

4. With regard to the first rejection on Page 5 concerning claim 35, step (c)(ii), the amendment to claim 35(c) overcomes any perceived ambiguity.

5. With regard to the second rejection starting on Page 5 concerning claim 35, step (c)(ii), deletion of the word “possible” overcomes this rejection.

With regard to the term “like” the examiner is manufacturing an ambiguity where none exists. In the context of alphabetic symbols which (as the examiner recognizes, are “fixed and definite”) the adjective “like” mean “same”. The specification uses these terms interchangeably [cf., for example, in the context of forming difference in position page 2, line 34 (“same”) with page 3, line 32 (“like”)]. There is no instance in this specification where two different symbols are said to be “like” symbols. The symbol --B-- is not “like” the symbol --A--.

6. With regard to the rejection on Page 6 concerning claim 35, step (c)(ii), the amendment to claim 35(c) changing the word “value” to “values” overcomes this rejection.

7. With regard to the rejection on Page 6 concerning claim 35, step (d), the amendment to this section of the claim (to “values”) is believed to overcome this rejection.

It appears that the examiner does not appreciate the term “multi-key sort”. A “multi-key sort” means that the k-tuple table is sorted multiple times, first using the last (k-th) suffix column as the sort key, then next using the next-to-last [(k-1)-th] suffix column as the sort key, and so on, until the first suffix column is used as the sort key. (See, page 31, lines 16-21.)

8. With regard to the rejection on Page 6 concerning claim 35, step (e), the claim clearly states that “a set of patterns” is defined by “collecting adjacent rows”. No term is necessary to define the organization of the collection.

The whole point of the multi-key sort is to discover adjacent rows containing identical difference-in-position values. Performing a multi-key sort necessitates use of all suffix columns. (See, page 31, lines 16-21.)

2. With regard to the rejection starting on Page 7 concerning claim 35, step (e), there is no ambiguity. The term “identical sets of difference-in-position values” means that each difference-in-position value in a given column in one row is the same as the corresponding value in that column of an adjacent row. There is no lack of antecedent basis because this section of the claim is the first instance in which the term “sets of difference-in-position values” is used.

B. Claims 36, 40 These rejections are traversed. There are no ambiguities. Any predetermined criteria may be used to define which patterns are to be deleted or rows to be deleted from the k-tuple table. (Particular criteria for deletion of patterns are recited in claims 37 and 38. A particular criteria for deletion of rows is recited in claims 41). These claims, although broad in scope, are not indefinite.

C. Claim 41 The amendment changing the phrasing of this claim clarifies the criterion for row deletions and therefore overcomes the rejection.

D. Claim 42 Pages 7 and 8 of the Office Action contain six rejections directed toward various portions of claim 42. These rejections are discussed in turn.

1. With regard to the rejection starting on Page 7 concerning claim 42, step (a), the amendment overcomes the rejection.

2. With regard to the rejection on Page 8 concerning claim 42, step (a), the amendment overcomes the rejection.

3. With regard to the rejection on Page 8 concerning claim 42, step (b), the amendment overcomes the rejection.

4. With regard to the first rejection on Page 8 concerning claim 42, step (c)(i), the amendment overcomes the rejection.

5. With regard to the second rejection on Page 8 concerning claim 42, step (c)(i), the preamble of this claim makes reference to the existence of “a k-tuple table” as a starting point for the formation of a (k+1)-tuple table. There is no reason to incorporate the particular limitations of claim 35 into this claim.

6. With regard to the third rejection on Page 8 concerning claim 42, step (c)(i), the response submitted in connection with claim 35, step (c)(ii) [Section V.A.5 of this Response] applies with equal vigor here.

E. Claim 43 The response submitted in connection with claim 35, step (c)(ii) [Section V.A.9 of this Response] applies with equal vigor here.

F. Claim 44 Page 9 of the Office Action contains four rejections directed toward various portions of claim 44. These rejections are discussed in turn.

1. With regard to the rejection starting on Page 9 concerning claim 44, step (A), the same argument made in Section V.A.9 of this Response applies here.

2. With regard to the rejection on Page 9 concerning claim 44, step (B), the amendment overcomes the rejection. The term “repeatedly” was used to measure the duration of the activity (“until all pairs have been stored”).

3. With regard to the rejection on Page 9 concerning claim 44, step (v), the amendment overcomes the rejection.

4. With regard to the first rejection on Page 9 concerning claim 44, steps (c) and (d), the amendments overcome the rejection. It is noted that the sequences are treated in a pair-wise manner [i.e., first-and-second sequences; second-and-third sequences, third-and-fourth sequences; etc., until (k-1)-and-k sequences]. (See, generally, page 2, line 28 through page 4, line 6 for discussion a basic Pattern Map; Page 29, line 35 through page 32, line 12 extending the basic Pattern Map to a tuple situation where more than two sequences are involved.)

G. Claim 45 Pages 10 and 11 of the Office Action contain five rejections directed toward various portions of claim 45. The amendment to the this claim overcomes all rejections.

H. Claim 49 Page 11 of the Office Action contains a rejection directed toward claim 49. The preamble of claim 35 has been amended to state clearly that w sequences are numbered from 1 to w. The amendment to claim 35 overcomes this rejection.

Regarding the amendment to step (A), see page 34, lines 20-21.

Regarding the ordering mentioned in step (A), the specification at page 36, line 35 through page 37, line 10 discusses the ordering of the linked list.

I. Claim 51 Pages 11 and 12 of the Office Action contain two rejections directed toward claim 51. These rejections are discussed in turn.

1. With regard to the rejection on Page 11 concerning claim 51, step (i), the preamble of claim 35 has been amended to state clearly that w sequences are numbered from 1 to w. The amendment to claim 35 overcomes this rejection;

2. With regard to the rejection on Page 12 concerning claim 51, step (ii), the amendment overcomes this rejection.

J. Claim 52 Page 12 of the Office Action includes a rejection directed toward claim 53. The amendment to claims 35 and 51 overcome this rejection.

K. Claim 53 Page 12 of the Office Action contains four rejections directed toward various portions of claim 53. The amendments to this claim overcome the antecedent basis rejections. These are discussed in turn.

1, 2. With regard to the first and second rejections on Page 12 concerning claim 53 original step (i), a new step “(i)” has been added to the claim to define a Virtual Sequence Array and to define its relation to the P-nodes and T-nodes. Antecedent support for this amendment is derived from Figure 11 and the pseudo-code at pages 49 and 50.

3. With regard to the rejection on Page 12 concerning claim 53, original step (ii) has been overcome by the insertion of new step (i).

4. With regard to the rejection on Page 12 concerning claim 53, original step (iii) has also been overcome by the insertion of new step (i).

L. Claim 66 The amendments to claim 66 are inserted for purposes of overcoming the Section 103 rejection.

The Section 112 rejection is traversed. The claim is clear as written.

The “data structure grouping ....” issue is discussed first. For each value of a difference in position between each occurrence of a symbol that occurs in a first and any subsequent sequence, the position index of each such symbol is grouped with the position index of other such symbols. There are no other values with which they may be grouped. This thought is expressed in both the original and amended claim language.

As to the second point, this claim is directed to a “plurality of data structures” created during the execution of a computer-implemented method. Once the w data structures in which the patterns are grouped are created, the patterns common to the sequences may be readily identified. This thought is expressed in both the original and amended claim language.

M. Claim 67 The amendment overcomes the rejection.

#### VI. Rejections under 35 U.S.C. § 103

Claims 66-67 have been rejected as obvious under 35 U.S.C. § 103(a) as evidenced by U.S. Patent 5,577,249 (Califano).

The rejection is traversed.

Claim 66 has been extensively amended to recite the w+2 data structures created in the computer-implemented execution of the method of claim 35. The data structures are not merely descriptive, but are essential to the operation of the computer.

The claimed data structures are distinguished from the Califano reference. This reference does not teach or suggest a data structure containing information regarding:

“difference in position between each occurrence of a symbol in one of the sequences and each occurrence of that same symbol in each other sequence”.

Dependent claim 67 further includes in the second additional data structure information regarding the number of symbols in the first sequence that appear in the second sequence at that difference-in-position value. This claim is also believed allowable.

#### VII. Renumbering of Claims Upon Allowance.

In accordance with the practice under 37 C.F.R § 1.126 the examiner is requested to renumber the claims upon allowance in accordance with the following table. The renumbering is believed appropriate to keep in sequence all claims dependent from original claim 35 and to present broader dependent claims before narrower ones. [Non-sequential renumberings are indicated by an asterisk (“\*”).]

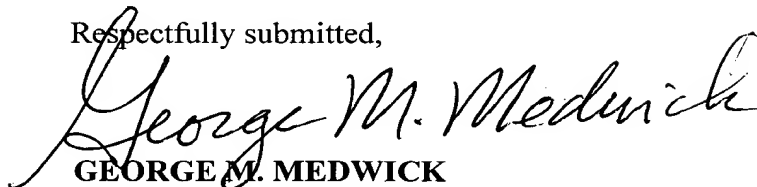
| <u>Original Claim Number</u> | <u>Allowed Claim Number</u> |
|------------------------------|-----------------------------|
| 35                           | 1                           |
| 36                           | 2                           |
| 37                           | 3                           |
| 38                           | 4                           |
| 39                           | 7 *                         |
| 40                           | 5 *                         |
| 41                           | 6 *                         |
| 42                           | 17 *                        |
| 43                           | 18 *                        |
| 44                           | 19 *                        |
| 45                           | 8                           |
| 46                           | 9                           |
| 47                           | 10                          |
| 48                           | 11                          |
| 49                           | 12                          |
| 50                           | 13                          |
| 51                           | 14                          |
| 52                           | 15                          |
| 53                           | 16                          |
| 66                           | 20 *                        |
| 67                           | 21 *                        |
| 68                           | 22 *                        |



VIII. Conclusion

For the reasons set forth hereinabove it is submitted that all of the rejections have been overcome and that this application stands in condition for allowance, which action is earnestly solicited.

Respectfully submitted,



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Enclosures